New model of managerial education in technical university

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Abstract

Purpose – A modern trend in the educational environment in recent years has been the permanent education system with the involvement of online study modes. It is based on multidisciplinarity and adaptivity of educational technologies, starting with the basic level of education – bachelor's degree, and ending with gaining competences in the field of engineering and economics throughout the whole professional life of a student. The purpose of this paper is to perform a detailed analysis of development of permanent education in Russian universities, focusing on statistical data on popularity of jobs as to professional groups among employers and determining peculiarities of permanent education, based on the distinguished peculiarities of permanent education and requirements of business to develop a model of engineering and managerial education that would integrate two blocks of the educational process – engineering and economic, as well as include modern technologies of teaching.

Design/methodology/approach – The authors propose the modern model of engineering management education that is implemented in the Russian technical universities. Its distinctive feature as compared to the conventional educational technologies is gaining competences in the field of economics and management at the same time with engineering education at the second stage of education – the master's program. The proposed model of engineering and management education results in obtainment of two diplomas by the student who is awarded with a master's degree in engineering and a master's degree in economics. A difference of the offered model from the traditional educational technologies is obtaining competences in the sphere of economics and management together with engineering education at the master's program. The result of the offered model of engineering and managerial education is graduate's receiving two diplomas with master's degree of engineer and master of economics. The paper shows the existing mechanism of implementing the model of engineering and economic education in a technical university by the example of the master's program in Economics "Evaluation of economic risks during technological decisions (in oil processing and oil chemistry)."

Findings – The offered model of engineering and managerial education will allow training the engineers of a new type, who will be able to adapt to new tendencies and initiate the changes that are necessary for effective functioning of business in the conditions of digital economy.

Originality/value – The offered model of engineering and managerial education should be acknowledged as an innovational educational project that raises demand for graduates through their adaptability to employer's needs and their usage of new tools of management that are based on exchange of information data and that form managerial task for information provision of the process of decision making and their further execution.

Keywords Technical university, Educational technologies, Managerial competences, Multidisciplinary education, Online study mode, Permanent education, Practice-oriented activity, Model of engineering management education, Master's programme, Joint degrees, Networking cooperation

Paper type Research paper

Goal

This paper is aimed at studying the peculiarities and specific features of permanent education, identifying the prerequisites for the development of innovative educational technologies, as well as the development of the modern model of engineering management education in the technical university which meets the criteria for adaptability and multidisciplinarity of the modern education.

Approaches

The primacy of understanding the idea and developing the abstract theorems of permanent education belongs to the representatives of foreign schools of philosophy, sociology and pedagogy.

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The elements of the future permanent education concept are reflected in the articles of early philosophers Solon, Confucius, Socrates, Plato, Aristotle and Lucius; subsequently, they were developed by pedagogical thought, including in such meaningful works as "Universal Education" ("Panediai" by Komenskiy *et al.* (1989) and "Guide for German teachers" by Diesterweg (1956)).

The modern conceptual framework of "permanent education" was presented by Lengrand at the UNESCO Forum in 1965, which defined this category as a process that lasts throughout life, an important role in which is the integration of the individual and social aspects of a human person and its activities (Lengrand, 1970).

The subsequent development of the permanent education concept as an alternative to the discrete educational system is due to the results of scientific analysis presented in the UNESCO records, including in the reports of Dave (1973) and Faure Edgar (1972) who describe permanent education as the organizing principle of the intrinsic motivation of a human being to education in order to improve the quality of life throughout life.

The core of the presented concept was the abstract theorems of Ravindra H. Dave, the head of the UNESCO Institute for Education, who describes the permanent education as "a term which includes formal, non-formal and informal (cinema, radio, video, television, books, etc.). training of an individual with the aim of achieving their fullest development in the personal, social and professional life which lasts throughout their life "(Klarin and Semionov, 1994) and who determined the features of the permanent education system (Dave, 1976). Dave referred to the permanent education system as both the properties that characterize the structure: encompassing of the entire life of a person with education (Ryzhikova, 2001); integrity of the education system; inclusion of formal, non-formal and non-institutional forms of education into the education system; combination of horizontal and vertical educational integration; coordination of general and vocational education; and qualitative properties: versatility and democratic character of education; focus on self-management, self-education, self-improvement, self-assessment; individualization of education, etc.

The permanent education concept has become the foundation for the educational reforms in most countries by the end of the 1970.

The authors' approaches to periodization of permanent education are demonstrated in the schematic summary of Prozorova (2009) (Table I).

According to Klochkova (2010), the existing authors' approaches to the identification of the essence of permanent education can be combined into three groups:

(1) who describe permanent education as vocational adult education, necessary compensation for skills and knowledge short received in the course of studies ("lifelong education");

(2) representing education as a process lasting a lifetime and taking place in organized structures (the existence of an institutional environment); and

(3) substantiating the idea of permanent education by the needs of an individual in self-knowledge and knowledge of the world around ("education throughout life").

The permanent education concept can be viewed under current conditions as an instrument of economic policy aimed at increasing competitiveness, achieving fuller employment of the population, as well as ensuring occupational mobility of employees resulting from the introduction of new technologies (Lomakina, 2006). Thus, the Memorandum on Permanent Education of the European Economic Community (Commission of the European Communities Brussels, 2000) declared the following principles of permanent education in 2000, in particular:

(1) New basic skills for all: guaranteeing universal and continuous access to education for gaining and upgrading the skills needed for sustainable participation in the knowledge society.

Table I. Development of permanent education: opinions of domestic researchers

Author	Onushkin and Kuliutkin (1989)	Osipov (1989)	Tonkonogaya (1981)	Churekova (2001)	Ogarev (2005)
Periodization principle	Chronological arrangement	Generality of subject and methodological principles	Critical stages in the comprehension of the phenomenon	Critical stages in the comprehension of the phenomenon	Goals
Stage 1	50th – early, 60th – elimination of deficiencies of school education of adults or subsequent acquisition of knowledge	50th–mid-60th – "ascertaining"	Up to mid-60th – post-secondary education for adults	1929 – concept formation, the First International Conference on Adult Education	Educational interpretation, the thesis of the inherent value of lifelong learning
Stage 2	60 – continuing education by occupation	Mid-60th – early, 70th – "phenomenological"	mid-60th–early 70th – the entire education system under the conditions of scientific and technical revolution and social and economic changes	1960 – concept development, the Second International Conference on Adult Education	Technological interpretation, functional moral depreciation of the production and technical skill and knowledge
Stage 3	Late 60th–early 70th – continuing education by occupation	Second half of the 70th – "methodological"	Early 70th–recent time – formation of a theory determining the essence of permanent education	1970 – theory development, the Third International Conference on Adult Education	Factor ensuring lifelong qualification
Stage 4	Mid-70th – a tool designed to adapt a person to social life	Late 70th–early 80th – "theoretic expansion and concretization"		1985 – profound theoretical justification of the concept	Lifelong refinement of the creative potential of an individual
Stage 5		Mid-80th–early 90th – practical application		Mid-90th – the urge to turn the permanent education system into reality	

(2) Increase in the investments in human resources: increase in the level of investment in order to give priority to Europe's most important asset – its people.

(3) Introduction of innovations in teaching and learning: development of efficient teaching methods and education for permanent lifelong education.

(4) Training assessment: improvement of approaches to the assessment of learning outcomes, especially non-formal and informal training.

(5) Development of mentoring and counseling: ensuring easy access for everyone to high-quality information and advices on education capabilities throughout Europe and throughout one's life.

(6) Approach of education to home: providing opportunities for lifelong education as close as possible to students in their own communities and support by means of the information technologies.

Without denying the importance of the above provisions for the implementation of the concept in the European educational system, we believe it is necessary to take into account the specific features of the national education system in order to integrate Russia into the world education space.

Therefore, we deem it possible to establish permanent education on the basis of principles singled out by Lomakina (2006): the principle of basic education; the principle of multiple-level system; the principle of diversification; principle of complementarity (mutual complementarity) of basic and extended education; the principle of maneuverability of educational programs; the principle of succession of educational programs; the principle of integration of educational structures; and the principle of flexibility of organizational forms.

Thus, the need for development of permanent education has been acknowledged by the entire world community. In order to assess the possibility and the prospects of its integration into the Russian educational practice, let us analyze the modern state and the development trends of the Russian higher education.

Let us examine the quantitative aspect of development of the Russian education that is presented in Table II.

After the collapse of the Soviet Union, Russian education faced a serious problem of underfunding, for the solution of which it was entitled to use a market-based approach and gradually learned how to use it. The number of educational establishments for higher education has doubled for the last ten years, and the number of students has increased by more than 1.9 times. The number of students in all modes of study was proportionally increasing as well.

The peak of the quantitative development of the Russian education fell on 2007–2010, when 7.5m people were simultaneously studying in the country, i.e. every 20th citizen (in contrast, in the 1990/1991 academic year – only every fiftieth citizen was studying). It stands to reason that such a rapid growth could not but have a negative impact on the quality of education. The fact is that, on the one hand, many non-state universities ready to teach anything and anyone for money, have emerged over the years. On the other hand, the universities of high renown were forced to introduce and subsequently extend the entrance to fee-based places.

At the initial stages, obviously lower-achieving "contract students" accounted for a small part of the population of students, and they had to make extra efforts to raise their knowledge level. However, in 2004–2005, the number of government-subsidized students with full reimbursement of expenses equaled out (about 2.9m people for each of the sources of funding). Then the number of government-subsidized places started decreasing at all, but the number of students in fee-based places was increasingly growing. In 2007–2009,

Years	Number of organizations	Total number of students, thousand people	Including by educational forms: Full-time form of study	Intra-extramural form of study	Extramural form of study	Number of students per 10,000 of population
1980/1981	494	3,045.7	1,685.6	401.0	959.1	219
1990/1991	514	2,824.5	1,647.7	284.5	892.3	190
1995/1996	762	2,790.7	1,752.6	174.8	855.8	189
2000/2001	965	4,741.4	2,625.2	302.2	1,761.8	324
2001/2002	1,008	5,426.9	2,880.6	335.6	2,138.1	376
2002/2003	1,039	5,947.5	3,104.0	346.0	2,399.9	414
2003/2004	1,044	6,455.7	3,276.6	351.3	2,703.7	448
2004/2005	1,071	6,884.2	3,433.5	361.8	2,942.5	480
2005/2006	1,068	7,064.6	3,508.0	371.2	3,032.0	493
2006/2007	1,090	7,309.8	3,582.1	372.3	3,195.9	512
2007/2008	1,108	7,461.3	3,571.3	352.9	3,367.9	523
2008/2009	1,134	7,513.1	3,457.2	343.7	3,540.7	526
2009/2010	1,114	7,418.8	3,280.0	323.6	3,639.2	519
2010/2011	1,115	7,049.8	3,073.7	304.7	3,557.2	493
2011/2012	1,080	6,490.0	2,847.7	263.4	3,289.7	454
2012/2013	1,046	6,075.4	2,724.3	229.7	3,051.4	424
2013/2014	969	5,646.7	2,618.8	189,2	2,838.6	393
2014/2015	950	5,209.0	2,575.0	158.5	2,475.5	356
2015/2016	896	4,766.5	2,379.6	149.1	2,237.8	325
2016/2017	818	4,399.5	2,403.0	124.2	1,872.3	300

Sources: Rossiyskiy Statisticheskiy Yezhegodnik (Russian Yearbook of Statistics), 2012, 2017

Table II. Educational establishments for higher education and scientific organizations implementing the educational activities in the bachelor's programs, specialist programs and master's programs (as at the beginning of the academic year)

the number of "contract students" was about 3.3m. In this situation, most universities could not maintain the previous level of requirements for students' knowledge.

As a result, the education has become more accessible, both from the point of view of the opportunity to enroll and from the perspective of the possibility of completing one's studies.

However, the state, in turn, responded by increasing the requirements for universities and conducting verifications of quality of their activities. As a result, the number of educational establishments for higher education has decreased by 28 percent to date, and the population of students has decreased by 41 percent.

Nevertheless, the number of issues in Russian higher education has not decreased. As before, they are as follows:

- underfunding and, as a consequence, declining skill level of teachers and the quality of the applicants;
- the static nature of educational programs, i.e. quite inert reaction to changes in the requirements of the labor market;
- prevalence of teachers who are not practitioners, which results in the insufficient handling competence of graduates; and
- the combination of higher vocational education with academic education, i.e. it became difficult to distinguish between where the executives and where the fundamental scientists should be trained.

In addition, Russian education is in a transitional state between the industrial and post-industrial model. The industrial model presupposes the provision and consolidation of a certain scope of knowledge in the learner. And this is the basis of his/her education. At the same time, approximately the same level of education is provided for the entire society, without considering the personal characteristics of an individual.

In the post-industrial model, there is a renunciation of collective education in favor of the personalized education. The focus is shifted from the transfer of knowledge to teaching how to receive this knowledge independently in accordance with the current need. However, neither students (due to low motivation and self-organization) nor teachers are ready for this yet.

There is some controversy as to the direction in which the education should be developed: multidisciplinarity or focused specialization. The first option is favored by the fact that there is a risk of not finding a job in a particular speciality, especially since there is a large percentage of graduates in our country who are employed either by related speciality or they have found a job in another profile. A focused specialization is required in those areas where there is explosive development and the scope of knowledge is growing rapidly.

It is safe to say that the market of educational services undergoes a rethinking stage. And many people have recently started wondering whether the higher education in the form in which it can be obtained today is really required for employment? What kind of education will allow a graduate to get a desired job with fair wage?

The answer to the first question is partly presented in Table III.

As we can see, the share of the unemployed who have higher education increased from 2000 to 2016 from 13.3 to 20.5 percent. And this growth is even more significant with women: from 14.8 to 24.3 percent. This means that modern higher education does not guarantee employment. What is the reason for that?

First, in respect to accessibility of education, when almost 90 percent of school graduates are admitted to the higher educational establishments. However, the structure of labor demand of organizations (Table IV) testifies that half of the vacancies do not demand any college degree from the applicants at all.

Second, the employers demand the presence of education which meets certain particular criteria.

As of today, the requirements can be classified into two groups: occupational and personal.

The following qualities refer to professional qualities (YYYYY, YYYY):

- availability of a good theoretical foundation;
- concept of future work;
- willingness to receive extended education;

Groups of the unemployed (by year)	The unemployed – total number	Higher education[a]	Including those who have Vocational secondary education In mid-tier specialist training program	In skilled laborer (employee) training program[b]	General secondary education	Basic general education	No basic general education
Total							
2000	100	13.3	26.3	12.2	31.5	14.1	2.6
2010	100	15.0	20.8	20.8	32.4	9.9	1.0
2014	100	18.2	19.7	20.2	31.5	9.6	0.9
2015	100	19.7	20.7	20.1	29.5	9.0	0.9
2016	100	20.5	20.5	19.9	29.8	8.7	0.6
Men							
2000	100	12.0	22.7	13.2	32.3	16.4	3.4
2010	100	12.9	17.5	23.9	33.1	11.4	1.2
2014	100	15.7	16.3	23.1	32.6	11.0	1.2
2015	100	16.5	17.9	23.2	30.5	10.9	1.0
2016	100	17.1	18.2	23.3	30.2	10.3	0.8
Women							
2000	100	14.8	30.3	11.1	30.6	11.5	1.7
2010	100	17.6	24.8	17.0	31.6	8.0	0.9
2014	100	21.2	23.7	16.7	30.1	7.8	0.6
2015	100	23.4	24.0	16.6	28.3	6.9	0.8
2016	100	24.3	23.1	16.0	29.4	6.8	0.4

Note: As percentage of total
Source: Rossiyskiy Statisticheskiy Yezhegodnik (Russian Yearbook of Statistics), 2017

Table III. Classification of the unemployed according to the educational level

Occupational group	Number	Share (%)
Total, including:	637,612	100.0
Managers	27,052	4.2
Highly skilled specialists	173,984	27.3
Mid-tier specialists	89,953	14.1
Employees involved in preparation and execution of documentation, accounting and service	28,656	4.5
Employees in the sector of service and trade, protection of citizens and property	68,960	10.8
Skilled laborers, rural and forest workers, workers of fisheries and fishing industry	4,866	0.8
Skilled laborers in manufacturing industry, building industry, transport industry and workers of related occupation	102,896	16.1
Operators of production units and machines, assemblers and drivers	69,711	10.9
Unskilled laborers	71,534	11.2

Table IV. Labor demand of organizations for filling the vacancies by occupational groups and types of economic activity (as at October 31, 2016 (XXXXX, 2016))

- presence of practical skills; and
- presence of extended education certificates.

Personal qualities:

- initiativity;
- high responsibility;
- ability to work in a team; and
- ability to work independently.

Strange as it may seem, the significance of personal characteristics is significantly higher than professional ones. Once again, this demonstrates the need of the labor market in particularly the post-industrial model of education, when a graduate does not just have a certain set of knowledge, but is willing (there are both the desire and the ability) to gain knowledge and skills in accordance with the current demands of the employer.

However, as we can see in the Table, the most significant category of vacancies consists of highly skilled specialists, where the college degree is certainly required. A research performed by Academician Zaslavskaya, T.I. (Avraamova *et al.*, 2006) showed that the following qualities are the most important for specialists of managerial level:

- ability to assume responsibility for decisions made;
- innovative mindset focused on the search for non-standard solutions;
- ability to organize team work on the project; and
- perseverance in the implementation of decisions.

Thus, the intellectual and volitional characteristics of a person are the key characteristics.

When it comes to managers involved in work in the technical field, then, in addition to professional and personal qualities, the availability of business education is increasingly frequently included in the list of demands.

Thus, for example, within the framework of the division of program of MAKS-2017 International Aviation and Space Show "Academic Science and Air Technical Creativity of Youth," a roundtable discussion "The X people: new approaches to engineering and management education"(ZZZZZZ, ZZZZ) was held, during which the following requirements to the educational environment were laid down:

- An acute need in the development of new approaches to the establishment of educational programs meeting the requirements of the economy and occupational standards and providing a continuous update of the learning content.
- Formation of an academic community for the establishment of educational programs that could be representative of the fast-changing engineering technologies and methodologies.
- Provision of a combination of interdisciplinary institutes (economic and technical) in the context of networking cooperation. However, it is necessary to find the possibility of the implementation of educational programs in the context within the framework of implementation of educational process in technical universities, allowing the student to gain managerial competences.

The implementation of the above requirements is achieved due to the modern level of the regulatory environment for the functioning of the Russian system of higher education. The Institution of Higher Education, being an educational establishment, has the right to determine the set of educational programs and the formation of a mechanism for their integration with the aim of developing managerial capacities, such as, engineering, organizational, administrative and analytical.

Methodology

At present, the training of students in a higher educational establishment is aimed at conforming to the innovative model of the development of the Russian economy and meeting the requirements of competition in the innovation market, labor market and education market.

Under the circumstances, the technical university becomes a platform for the engineering management education. The main difference of this model is the integration of

education programs for the training of technical specialists of a new generation with extended competences in the formation and use of industrial and economic information in making managerial decisions in the professional field and able to show integrated thinking as the main quality necessary for each manager in the future. The primary benefit of the model of engineering management education is its high level of provision of permanent education and its adaptivity to the requirements of the modern labor market.

The proposed model is based on the progressive development of educational programs according on the following main levels:

(1) training in the programs of the vocation-related technical bachelor's program, which results in acquiring of basic knowledge in the field of engineering processes and establishment of the corresponding profession-oriented competences and professional skills;

(2) preparation in the master's programs in which two master's degrees are obtained: master's degree in technology and master's degree in economics (management); and

(3) the learning of additional educational programs both during the preparation period at the first and the second above-mentioned level, and in the following years of professional life.

Managerial competences, which distinguish a modern engineer, start to develop and gain recognition of the potential employers at the second level of the model of engineering management education.

The model of engineering management education includes three components:

(1) Educational – it is the environment which promotes permanent economic education: the construction of an individual, multi-level trajectory of training of a specialist, capable of being an effective manager of the innovation process.

(2) Personnel – educationary teacher, researcher, consultant, project manager, industry practitioners.

(3) Scientific, research and project – focus on the needs of the innovative economy through the real cooperation with high-tech enterprises by means of the integration of theory, scientific and project activities.

It must be admitted that the most significant component is the human resources of an Institution of Higher Education which participates in the implementation of the educational program and transfers its knowledge and experience to the students. The share of part-timers from other fields of activities – science, business, state and municipal management in the structure of human resources – is growing. The functioning of the basic academic departments, which are part of the university as structural subdivisions of the departments, demonstrates high efficiency within this framework.

The goal of functioning of the basic academic departments consists in the implementation and improvement of the educational process, strengthening of its practical focus through the involvement in the teaching of disciplines of the professional cycle of the bachelor's program and the master's program, as well as to manage the practical training of highly skilled practitioners, as well as scientific potential of the back-up organizations. The basic academic departments serve as the platforms for internships and practical training of the students, during which the students have the opportunity to become familiar with and participate in the performance of particular occupational functional duties in financial and economic services.

The proposed model of engineering and management education allows us to approach the concept of the outstanding Soviet and Russian philosopher – the founder of the

systemic mental activity methodology Schedrovitsky in which the management activity is considered as the activity over activities. There are no ready-made managerial decisions in management activity that is why the modern engineer must be capable of independently setting and solving a process task based on abilities, forming a request for information and using it to analyze and control the implementation of this task0solving process and to evaluate its result under the conditions of uncertainty and risks.

Results

Attention invited to the Russian practice in the form of implementation of the proposed model of engineering and management education in a technical university (through the example of Petroleum University).

Since 2017, the engineering and economic master's programs have been implemented in the petroleum university, in which two degrees are obtained. It means that on graduation the student gains his/her first diploma in his/her main profession-oriented technical program (e.g. a program called "Oil and Gas Engineering" or "Fuel and Gas Chemistry"), while the student gains his/her second diploma in the program called "Estimation of economic risks when making process engineering decisions."

The main features of the programs are as follows:

(1) the recognition of the results of the interim attestation by re-recognizing the results by the disciplines in the context of the main technical program in the results by the disciplines of the economic program;

(2) the minimum number of full-time classes (provision is made for two to three double periods per week), the rest of the classes are given with the use of online study modes; and

(3) implementation of operational practice for acquiring professional and managerial competences in the basic academic departments of the core businesses.

The curriculum of the master's program in Economics "Assessment of economic risks when making process engineering decisions (in crude oil refining and petroleum chemistry)" is presented in Table V.

As we can see from the curriculum, a group of economical disciplines is added to the main vocation-related engineering disciplines in each semester. The theoretical skills are mastered during practical training and work experience internship.

The algorithm for mastering the master's program in Economics "Assessment of economic risks when making process engineering decisions (in crude oil refining and petroleum chemistry)" is shown in Figure 1.

Hence, the proposed mechanism of implementation of the master's program for obtaining joint degrees allows us to prepare a planning engineer who will be able to use new management tools based on the exchange of new data, to form a managerial task for the information support of decision-making process and subsequent execution of decisions made.

The employers expect the engineers to have almost the same skills as the specialists from finance departments for business valuation, and the data-processing specialists should be capable of creating an information environment that can reduce the risk component.

Value

A new type of engineer such as a graduate, being a subject of the proposed model, will be able to adapt to new trends and independently initiate the changes necessary for the effective business operation in an information economy.

Year 1		Year 2	
1st semester	2nd semester	3rd semester	4th semester
Science Philosophy and Methodology (3 ZE)	Business Foreign Language (3 ZE)	Business Foreign Language (2 ZE)	
Public Procurement/Internal Procurement Management (3 ZE)	Economic Analysis and Production Management (2 ZE)	Technical Foreign Language (2 ZE)	
Actual Problems of Legal Regulation of Business (3 ZE) Computer Technologies in Economics (3 ZE)	Basic Risk Management (3ZE) Business Planning and Budgeting at the enterprise (2 ZE)	Diagnosis of the financial condition of the enterprise (3 ZE) Economic Risks: methodology for analysis, prediction and management (4 ZE)	Enterprise Performance Management (3 ZE) Enterprise Value Assessment (3 ZE)
Pressing Issues of Taxation of Legal Entities (2 ZE)	Compliance Control in the activity of the enterprize (2 ZE)	Managerial aspects of International Financial Reporting Standards (4 ZE)	Work Experience Internship (21 ZE)
Theoretical and Experimental Methods of Research in Chemistry (2 ZE)	Cost Management and Controlling (2 ZE)	Work Experience Internship (9 ZE)	Research (12 ZE)
Industrial Ecology or Environmental Industrial Safety in the Design of Petrochemical and Petroleum Refineries (2 ZE)	Design of Petroleum Refineries and Petrochemical Enterprises (3 ZE)	Internship in obtaining the professional abilities and professional work experience (3 ZE)	Pre-graduation Internship (9 ZE)
Work Experience Internship (6 ZE) Research (6 ZE)	Theory of Chemical Processes of Natural Energy Carriers and Carbon-base Materials (3 ZE) Optimization of Chemical Technology Processes (4 ZE)	Research (6 ZE)	State Final Examination (9 ZE)
			Preparation for defense and procedure for defense of graduate qualification work (9 ZE)
	Practical Training (6 ZE) Internship in obtaining the primary professional abilities and skills (6 ZE)		
	Work Experience Internship (6 ZE)		
	Research (6 ZE)		

Notes: – The economical disciplines are highlighted in red; – the engineering disciplines are highlighted in green; – the practical aspects of learning of profession-oriented competences are highlighted in blue

Table V.
Curriculum of the master's program in Economics "Assessment of economic risks when making process engineering decisions (in crude oil refining and petroleum chemistry)"

The proposed model of engineering and management education should be recognized as the innovative education project which not only promotes the demand for the graduates and increases attractiveness in the eyes of the graduates through the increased adaptivity of a graduate to the conditions in the labor market, but also allows shifting the conventional organizational and technical level to a level which corresponds

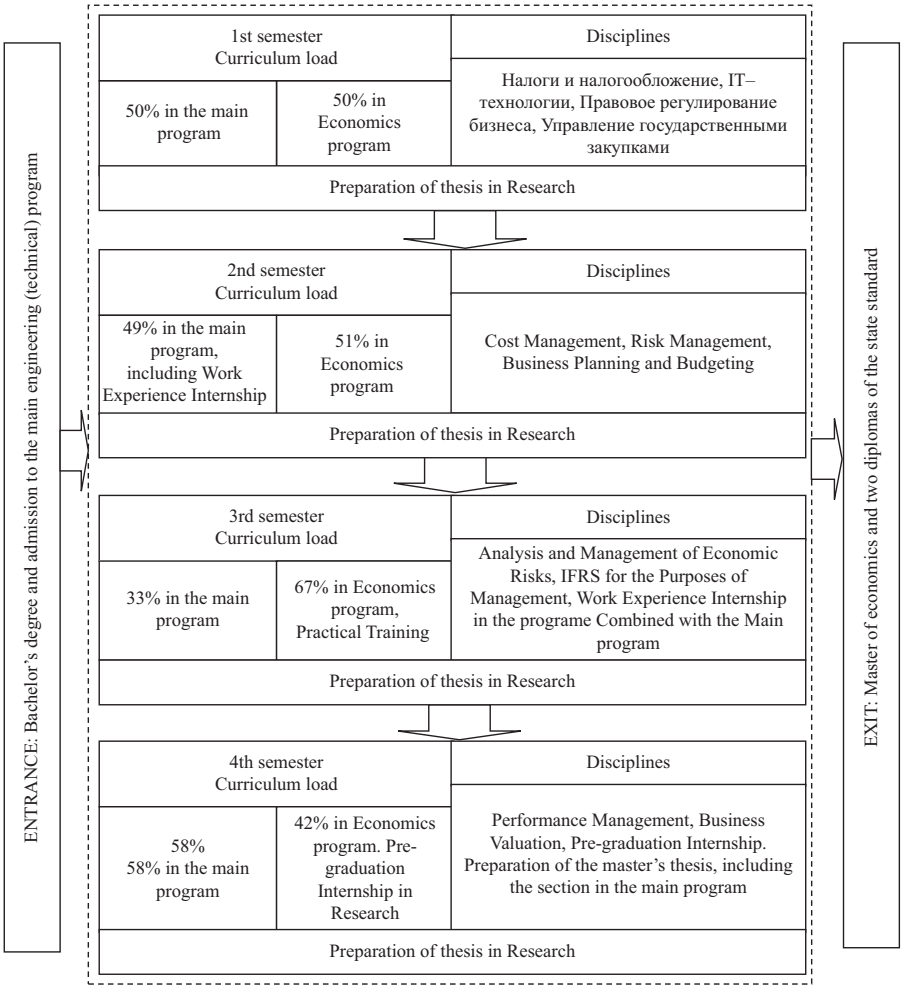

Figure 1.
Algorithm for mastering the master's program in Economics "Assessment of economic risks when making process engineering decisions (in crude oil refining and petroleum chemistry)"

to the new information technologies in educational process with the use of online study modes, such as:

(1) Theoretical information is suggested to be studied with the use of the slides with an audio track (audio lecture). Testing and evaluation of theoretical skills should be performed through the remote testing system.

(2) The use of video lectures.

(3) All course materials (files of lectures, tasks for practical and laboratory works (with a description of features of their performance), tests for testing the final knowledge) can be posted on any web portal designed for online study.

(4) The testing and evaluation of skills and abilities should be performed through the exchange of files of the tasks directly with the teacher with the use of the online education system.

Conclusions

The training of graduates with the use of a new model of engineering management education allows increasing competitive advantage of graduates due to the fact that they have a set of management skills which can be described as "unique" when compared to the traditional mode of study with engineering graduates who obtained traditional academic education.

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